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2. Landfill Area

LA-1
Excavation and On-site Incineration

This alternative would involve the excavation and incineration of approximately 12,300 cubic yards of landfill soils and wastes and involves equipment and operations similar to TSA-1. Landfill soils and wastes would be excavated, separated, and processed as necessary, to prepare them for incineration in a mobile rotary kiln. Because of the variety of materials which were place in the landfill, it is expected that landfill wastes will require a greater effort to sort than the TCE spill area soils. It is also expected for this same reason, that a larger volume of materials will be generated which cannot be incinerated. The wastes that cannot be incinerated, which may include discarded mill equipment and building debris, may require some type of decontamination prior to their disposal. The disposal will be in accordance with federal and state solid waste requirements.

The efficiency of rotary kiln incinerators for destroying organic hazardous materials is well proven and a destruction and removal efficiency (DRE) of 99.99% or greater is anticipated for the organic materials in the landfill area. Material of an organic nature makes up a majority of the volume of landfill wastes expected to be excavated, but smaller quantities of inorganic compounds, primarily trace metals, were found in the landfill as described in Section V.A.2. of this document. Most trace metals would not be removed by incineration and will accumulate in the bottom ash. During the excavation of landfill wastes a foaming agent or other synthetic material would be employed to suppress dust and vapor emissions. Stockpiled landfill wastes would be stored, prior to disposal, in a lined containment area and would remain covered with polyethylene sheeting.

The major ARARs for this alternative would be similar to those described for TSA-1 and include state and federal Hazardous Waste Regulations, and federal and state air emission standards. Since the landfill is considered a wetlands under state regulations, state laws concerning the protection of wetlands will be an ARAR. In addition, sections of the landfill are in the 100-year floodplain of the Branch River and federal policies regarding floodplains would be considered.

Landfill wastes are not known to contain listed RCRA wastes, but further testing would be needed to determine if the wastes exhibit a hazardous waste characteristic. If the wastes exhibit a RCRA hazardous waste characteristic then LDRs would be applicable to this alternative. Even if the wastes do not exhibit a RCRA hazardous waste characteristic, the toxicity of the compounds already found in the landfill would make LDRs relevant and appropriate for this alternative. It is expected that incineration could achieve the treatment limits established by the LDRs.

Before implementing this alternative, site preparation activities including grading, staging pad construction, security fence construction, and utility hookup would have to be completed. Prior to the full-time operation of the incinerator a series of test burns would be required to determine the optimum operating parameters of the rotary kiln.

The principal residue expected to be produced during the operation of the incinerator is the bottom ash with smaller quantities of scrubber liquor and fly ash produced. Bottom ash, which is composed primarily of the inert inorganic elements (i.e., trace metals), would require testing to determine if it exhibits a RCRA hazardous waste characteristic. In the event that the bottom ash is a hazardous waste it would be treated consistent with LDRs and disposed of in a RCRA facility, off-site, in conformance with state and federal requirements. The scrubber liquor and fly ash are residues from the pollution control equipment used for treating air emissions. The fly ash and scrubber liquor will also require testing, and based upon the results, will be disposed of appropriately. The options that were considered for the waste scrubber liquor include: disposal into a municipal sewer with or without treatment and on-site or off-site treatment.

ESTIMATED TIME FOR CONSTRUCTION:	3 Months
ESTIMATED TIME FOR OPERATION:	3 Years
ESTIMATED CAPITAL COST:	$17,960,700
ESTIMATED O & M (Cost/Year):	$ 100,000
ESTIMATED TOTAL COST (Present worth):	$18,815,840

LA-3
Capping Including Consolidation

This alternative would involve the consolidation of approximately 550 cubic yards of landfill wastes beneath a new multi-layer cap to be installed on the landfill. A schematic of the multi-layer cap, designed to meet the requirements of RCRA (40 CFR Part 264, Subpart N), and the proposed limits of excavation can be found in Appendix A, Figure 10. Emissions created by the excavation would be minimized by using a foaming agent or other synthetic material to cover excavated wastes. Erosional control measures would be implemented during excavation of landfill wastes and consolidation activities to reduce the potential effects on the adjacent Branch River. Once the waste is removed from the 100-year floodplain of the Branch River, and the side slopes of the landfill have been stabilized and covered with a RCRA cap, the area of the landfill subject to the 100-year flooding would be further protected by placement of a stone layer (e.g., rip-rap) over it.

The multi-layer cap system will include a vegetative layer, a drainage layer, and an impermeable barrier (e.g., a low permeability barrier of clay and synthetic liner material). A leachate collection system is to be constructed along the southern toe of the landfill. Any leachate generated would be discharged into the existing on-site sewer line, subject to meeting all State of Rhode Island pre-treatment requirements and receiving approval from the Woonsocket wastewater treatment plant. The leachate generated from the landfill is not expected to exceed pretreatment standards and therefore require treatment prior to its discharge into the sewer system based upon data obtained during the RI.

An environmental monitoring program consisting of surface water and sediment sampling in the Branch River will be implemented to assure that the leachate collection system is meeting the response objectives of this Record of Decision. The details regarding the environmental monitoring program, including the frequency of sampling, sampling locations, and parameters to be sampled will be decided during the design phase.

A passive gas collection system may be required to control the potential releases of volatile emissions. The cap design would incorporate the existing manholes which currently provide access to the on-site sewer line traversing the landfill. The manholes will be raised to the new surface of the cap to continue to provide access to the sewer line. Institutional controls in the form of deed restrictions would be implemented to limit further land use of the landfill area. EPA has proposed, in a consent decree lodged in federal court, institutional controls with the current owner -- Hydro-Manufacturing -- to protect the remedy. An extended policy of inspections and maintenance would be needed over the life of the landfill to insure that the remediation goals continue to be met over time.

Because of the location of the landfill, as explained under LA-1 above, state wetland requirements and federal floodplain policies are ARARs for this alternative. One of the purposes of state and federal hazardous waste regulations is to minimize the risks posed by hazardous wastes by providing for their safe disposal. Although no known hazardous wastes were disposed of in the landfill, other hazardous substances as defined by CERCLA have been disposed of there. These hazardous substances disposed of in the landfill present a potential risk to public health and the environment. Since the disposal of hazardous substances in the landfill at the Site presents circumstances sufficiently similar to those being regulated under state and federal hazardous waste regulations, these regulations would be relevant and appropriate to the closure of the on-site landfill. RCRA LDRs are not an ARAR for LA-3 because all wastes to be excavated are either within the confines of the existing landfill or contiguous to the landfill; therefore, there will be no "land disposal" within the meaning of RCRA.

Wastes identified in the landfill area have been found to contribute a lower long-term threat than the principal threats identified at the Site. Therefore, in accordance with the NCP it is appropriate to consider engineering controls, such as containment, to address these threats.

ESTIMATED TIME FOR CONSTRUCTION:	6 Months
ESTIMATED TIME FOR OPERATION:	30 Years
ESTIMATED CAPITAL COST:	$ 587,750
ESTIMATED O & M (Cost/Year):	$ 62,000
ESTIMATED TOTAL COST (Present worth):	$1,172,000

LA-5
<u>No-Action</u>

This alternative is included in the FS, as required by CERCLA, to serve as a basis for comparison with the other source control alternatives being considered for the landfill area.

The no-action alternative for the landfill area would not involve any treatment of the contaminated soils and materials. However, in order to provide minimal protection of human health and the environment, the no-action option would require the placement of a vegetative soil cover over the landfill area. The area would be cleared and graded to provide surface runoff, and then covered with clean fill and vegetated with a low maintenance growth cover.

Institutional controls would be implemented to limit future use of the area. A long-term groundwater monitoring program, which would be implemented along with the groundwater extraction and treatment alternative selected, would monitor the groundwater in the vicinity of the landfill area. Contaminants from the landfill have been detected in sediments found in the Branch River and this alternative would not eliminate the continued release of contaminants from the landfill into the river. Therefore, this alternative does not help meet any identified ARARs.

ESTIMATED TIME FOR CONSTRUCTION:	2 Months
ESTIMATED TIME FOR OPERATION:	2 Months
ESTIMATED CAPITAL COST:	$ 30,140
ESTIMATED O & M (Cost/Year):	$ 18,500
ESTIMATED TOTAL COST (Present worth):	$204,540

B. Management of Migration (MM) Alternatives Analyzed

Management of migration alternatives address contaminants that have migrated from the original source of contamination. At the Stamina Mills Site, contaminants have migrated from the TCE spill area into the bedrock aquifer beneath the Site as well as into the on-site raceways and from there into the Branch River. As discussed in Section V.C. of this document, contaminated groundwater is currently found approximately 500 feet northwest of the Site as a result of pumping activities of residential wells and a community well north of the Site. The plume appears to be slowly receding toward the spill area and the Branch River, now that pumping activities directly north of the Site have ceased. The management of migration alternatives evaluated for the Site have been divided into two groups. The first group addresses the extraction and treatment of contaminated groundwater in the bedrock aquifer and the second addresses the migration of contaminants through the on-site raceways. The filling and sealing of the raceways is only one component of the overall Site remedy which also deals with the buried on-site septic tank, demolition of partially standing structures, and removal of debris piles.

Contaminated groundwater has been identified as one of the principal threats found at the Site and therefore the use of treatment in remediating the groundwater is preferred by EPA. The migration of contaminants through the raceways is believed to contribute a lower long-term threat than principal threats identified at the Site, and therefore, it is appropriate to consider engineering controls, such as containment, to address this threat. The following management of migration alternatives were developed for the groundwater extraction and treatment and overall Site:

Groundwater Extraction and Treatment (GW)

GW-1: Air Stripping;

GW-2: Granular Activated Carbon;

GW-4: Ultraviolet Light and Hydrogen Peroxide;

GW-5: No-action;

Overall Site (OS)

OS-3: Building Demolition, Sealing Raceways, Location and Excavation of Septic Tank, and Site Grading;

OS-4: Building Demolition, Sealing Raceways, Location and Excavation of Septic Tank, Excavation of PAH "Hot Spot", Site Grading;

OS-5: No-action.

1. Groundwater Extraction and Treatment

As identified in Section 4 of the FS, the principal objectives for the groundwater remedial action is to return the groundwater within the contaminated plume to federal and state drinking water quality standards within a reasonable time frame. EPA's preference for contaminated groundwaters that are currently a source of a drinking water supply, such as those found in the bedrock aquifer at the Site, is to design an extraction and treatment system for rapid restoration, when technically practicable. The minimum restoration time frame for the Site will be determined by hydrogeological conditions, physical properties of contaminants found in the groundwater at a site, and the size of a plume. EPA is aware that the subsurface conditions found at the Site present inherent difficulties that may affect achieving the cleanup of the groundwater in the time frame estimated for all treatment alternatives, approximately 10 to 15 years. As a result, EPA will conduct a complete evaluation of the treatment system within five years of the start up of the treatment system, regardless of which treatment system is chosen. If the evaluation reveals that the remedy cannot achieve the stated cleanup levels, or that they cannot be reached in a reasonable time frame, then consideration will be given to making changes in the remedy.

The groundwater beneath the Site has been classified under the draft, State of Rhode Island Groundwater Protection Regulations as GAA, non-attainment (i.e., groundwater which must be restored to drinking water quality) with the exception of the landfill area which has been classified as GB (i.e., groundwater which has been degraded but will not require cleanup). Since this groundwater classification system has not yet been adopted, the federal groundwater classification system which is based upon EPA's Groundwater Protection Strategy will apply to the Site. Under this classification system, groundwater within a two mile radius of the Site boundary, has been identified as Class II, Subclass IIA. This classification indicates that the groundwater within the two mile radius of the Site is being used as a current source of drinking water.

During the FS assumptions were made regarding design details of the extraction system based on the information that was available at the time. Many of these details, including the specific number of extraction wells, depth, pumping rates, and locations, will only be defined upon completion of a predesign pump test. To allow for a comparison in the FS of the differences between treatment technologies, the following assumptions for the extraction system were held constant for each groundwater treatment alternative. All groundwater treatment alternatives were based upon: 1) the placement of two extraction wells, 2) a maximum combined pumping rate of 40 gallons per minute (gpm), 3) the extension of each well to approximately 200 feet below the ground surface, and 4) the casing of each well over the upper 50 feet of bore hole.

The pumping rate of 40 gpm was based upon a pulsed-pumping scenario. In a pulsed-pumping scenario, a maximum flow rate of 40 gpm might be seen for short durations. Therefore, this pumping rate was used to provide a conservative estimate of what the maximum capital costs and operation and maintenance (O&M) costs would be for each alternative. Although a flow rate of 40 gpm was used for costing purposes, a lower flow rate of 10 gpm was used for calculating cleanup times. This lower flow rate, which was based upon actual pumping yields from nearby wells and an off-site pump test, was believed to be more representative of a reasonable yield from the bedrock aquifer on a long term basis. As described above the results of the predesign pump test will help validate these assumptions.

A pretreatment step would probably be necessary to remove inorganic compounds and solids in the extracted groundwater prior to treatment. A pressure filtration unit is assumed for all groundwater extraction and treatment alternatives and has been included in the costing of each alternative. This pretreatment unit would be primarily designed to remove suspended metal ions, primarily iron and manganese. Bench-scale laboratory testing, as part of the predesign work, will determine if any additional pretreatment is necessary. The bench-scale testing would focus on the necessity of removing soluble metal ions in order to meet discharge requirements.

Three methods of disposal for treated groundwater were discussed and compared in the FS. These included: on-site surface water discharge, disposal via an on-site sewer hookup to an off-site publicly owned treatment works (POTW), and on-site subsurface discharge. The on-site subsurface discharge was selected during the FS but EPA believes at this time that the on-site surface water discharge may be the most appropriate and feasible disposal alternative. The final decision on what discharge alternative will be used for treated groundwater will be made during design based upon the results of predesign activities which will include pilot testing of the groundwater treatment technology. Should the results of the pilot testing of the groundwater treatment technology indicate that the effluent would not meet Rhode Island water quality criteria then the additional costs of treating the water to meet water quality criteria as well as the feasibility of the other two discharge options would be considered.

GW-1
<u>Air Stripping</u>

This alternative would treat the extracted groundwater using a system consisting of air stripping, vapor phase granular activated carbon (GAC), and liquid phase GAC polishing. Extracted groundwater is pumped to the top of an air stripping tower filled with an inert packing material while clean air is forced up through the tower. The packing material provides a large surface area over which groundwater and air can come in contact, and where contaminants can be transferred from the groundwater to the air.

The air stripper to be designed for the Site would consist of approximately 40 feet of packing material and is expected to achieve about 99 percent removal for the VOCs found at the Site. Assuming this removal rate, the remaining TCE concentration in the treated groundwater would still exceed drinking water quality standards and therefore require the use of a polishing step consisting of liquid phase GAC. The air emissions would also be treated using a vapor phase GAC system to meet state and federal air emission standards. Carbon residues generated from the liquid polishing step and treatment of air emissions would require off-site disposal and treatment. These residues will contain elevated levels of TCE and therefore be subject to the requirements of State and Federal Hazardous Waste Regulations pertaining to the generation, transportation, and disposal of hazardous wastes. In addition, Rhode Island Pollutant Discharge Elimination System (RIPDES) requirements, state pretreatment requirements, and Rhode Island Underground Injection Control Regulations (UIC) would be important ARARs for the three discharge options being considered for the disposal of treated groundwater. Prior to full operation of the air stripper, pilot testing will be required to ensure that all air emissions and effluent discharge limitations would be met.

Construction activities associated with the implementation of the air stripping alternative are minimal and are similar for all groundwater treatment alternatives. Activities include the drilling and installation of extraction wells; plumbing and piping installation to and from the air stripper; grading and preparation of the staging area; and utility hookup.

The time frame to achieve groundwater restoration is estimated to be 10 to 15 years based upon modeling. This time frame is the same for all groundwater treatment alternatives and is primarily dependent upon the subsurface conditions found in the bedrock aquifer. Quarterly monitoring of the groundwater from selected wells would also be considered part of all groundwater treatment alternatives.

ESTIMATED TIME FOR CONSTRUCTION:	2 Months
ESTIMATED TIME FOR OPERATION:	10 - 15 Years
ESTIMATED CAPITAL COST:	$1,537,140
ESTIMATED O & M (Cost/Year):	$ 139,525
ESTIMATED TOTAL COST (Present worth):	$3,190,010

GW-2
<u>Granular Activated Carbon</u>

This alternative is identical to alternative GW-1 with the exception that the method of treatment for the groundwater is solely a liquid phase granular activated carbon (GAC) system. Based upon the concentrations of VOCs detected in the groundwater two 20,000 pound carbon units would be required to achieve the desired cleanup levels. Carbon replacement for both units would be needed on a monthly basis initially but carbon usage is expected to decrease with time.

The effectiveness of GAC for removing TCE and most VOCs is well proven. A bench-scale treatability study was conducted using groundwater from the Site to determine the applicability of this technology to site-specific contaminants. The analytical results obtained from the treatability sample were not in line with the results of the sampling which occurred during the RI. Very high concentrations of the contaminant vinyl chloride were detected by the company performing the accelerated carbon test. EPA believes, based upon the fact that these results differ significantly from all of the groundwater sampling results obtained during the RI, and the fact that the company performing the treatability study had concerns about their own analytical results, that the treatability study results cannot be used without additional confirmation through sampling and analysis. Quarterly monitoring of the groundwater from selected wells, which is considered part of all groundwater treatment alternatives, would help indicate any changes in groundwater contaminant makeup such as those which can produce vinyl chloride.

The significance of the presence of vinyl chloride is that vinyl chloride is very difficult to treat using carbon adsorption and there is a possibility that cleanup levels could not be achieved using GAC. Prior to full operation of the GAC system, pilot testing would be required to ensure that all cleanup levels and effluent discharge limitations would be met.

Construction activities associated with the implementation of the GAC alternative are minimal and are similar for all groundwater treatment alternatives. Activities would include the drilling and installation of extraction wells, plumbing and piping installation to and from the GAC units, grading and preparation of the staging area, and utility hookup.

The time frame to achieve groundwater restoration is estimated to be the same for all groundwater treatment alternatives, approximately 10 to 15 years. The uncertainty associated with this time frame is discussed in the introduction to the groundwater extraction and treatment section (Section VIII.B.1.) above.

There are no air emissions associated with this treatment alternative. Therefore federal and state air pollution control regulations will not be ARARs. Carbon residues generated from the groundwater treatment would require off-site treatment and disposal. These residues will contain elevated levels of TCE, a RCRA hazardous waste. Therefore state and federal hazardous waste regulations pertaining to the generation, transportation, and disposal of the spent carbon, are ARARs. RIPDES, POTW pretreatment requirements, and UIC regulations are potential ARARs for the three discharge alternatives being considered.

ESTIMATED TIME FOR CONSTRUCTION:	2 Months
ESTIMATED TIME FOR OPERATION:	10 - 15 Years
ESTIMATED CAPITAL COST:	$1,789,425
ESTIMATED O & M (Cost/Year):	$ 114,225
ESTIMATED TOTAL COST (Present worth):	$3,262,792

GW-4
<u>Ultraviolet Light and Hydrogen Peroxide</u>

This alternative utilizes an innovative technology to destroy VOCs so that the only residuals produced are carbon dioxide, water, and very small quantities of free chlorides which go on to form simple salts. The technology uses ultraviolet (UV) light to react with hydrogen peroxide to form hydroxyl radicals which then react with and destroy organic contaminants.

The system, which was sized for the 40 gpm groundwater extraction rate, consists of a self-enclosed treatment unit approximately two feet wide by three feet long and five feet high and also includes a 300 gallon hydrogen peroxide storage tank. A bench-scale laboratory test was completed using groundwater from the Site and it was found that TCE levels could be destroyed down to a level below the drinking water quality standard within an exposure time of approximately three minutes. Although vinyl chloride was not detected in the sample submitted for the UV/hydrogen peroxide treatability test, this system has been shown to be effective in destroying this compound.

Prior to full operation of the UV/hydrogen peroxide system, pilot testing will be required to ensure that all cleanup levels and effluent discharge limitations would be met. Quarterly monitoring of the groundwater from selected wells would also be considered part of this alternative.

Construction activities associated with the implementation of the UV/hydrogen peroxide alternative are minimal and are similar for all groundwater treatment alternatives. Activities include the drilling and installation of extraction wells, plumbing and piping installation to and from the UV/hydrogen peroxide system, grading and preparation of the staging area, and utility hookup.

The time frame to achieve groundwater restoration is estimated to be the same for all groundwater treatment alternatives, approximately 10 to 15 years. The uncertainty associated with this time frame is discussed in the introduction to the groundwater extraction and treatment section (Section VIII.B.1.) above.

There are no air emissions or residues produced as a result of this treatment alternative. Therefore the only major ARARs would be those regarding RIPDES, POTW pretreatment requirements, and UIC regulations for the discharge alternatives being considered.

ESTIMATED TIME FOR CONSTRUCTION:	2 Months
ESTIMATED TIME FOR OPERATION:	10 - 15 Years
ESTIMATED CAPITAL COST:	$ 705,890
ESTIMATED O & M (Cost/Year):	$ 73,500
ESTIMATED TOTAL COST (Present worth):	$1,889,760

GW-5
<u>No-action</u>

This alternative is included in the FS, as required by CERCLA, to serve as a basis for comparison with the other management of migration alternatives being considered for the groundwater.

The no-action alternative for the on-site groundwater is also the no-action alternative for the entire Site. Under this alternative, there would not be any treatment of the contaminated groundwater. However, in order to provide minimal protection of human health and the environment, the no-action option would include quarterly sampling of selected existing monitoring wells to monitor the condition of the groundwater contaminant plume. An estimated 70 to 175 years would be needed to achieve the cleanup levels for the groundwater if this alternative were implemented along with one of the source control alternatives which involves treatment of the TCE spill area soils. An estimated 300 years would be needed to reach groundwater cleanup levels if nothing were done to eliminate the spill soils as a continuing contaminant source. The no-action alternative does not help meet the remediation levels for the groundwater and also does not return the groundwater to its beneficial use in a reasonable time period as described in the NCP and further defined in EPA's Groundwater Protection Strategy.

ESTIMATED TIME FOR CONSTRUCTION:	0 Months
ESTIMATED TIME FOR OPERATION:	70 - 175 Years
ESTIMATED CAPITAL COST:	$ 6,850
ESTIMATED O & M (Cost/Year):	$ 46,200
ESTIMATED TOTAL COST (Present worth):	$442,372

2. **Overall Site**

OS-3
Building Demolition, Sealing Raceways, Location and Excavation of Septic Tank, and Site Grading

This alternative would include the demolition of the on-site structures, location of the septic tank, removal of its contents, and sealing and filling of the two raceways. At the conclusion of these remedial activities and in conjunction with the source control actions and other management of migration action taking place, the entire five acre site would be graded and covered with a vegetative soil covering, and the perimeter fencing would be enhanced.

The first activity which would have to take place under this alternative would be the demolition and removal of the remaining structures. The implementation of any of the overall Site alternatives cannot safely take place until this step is completed. The wood and metal material encountered during demolition would be removed to an off-site disposal area. Construction materials of an earthen nature (i.e.,bricks and concrete) would be disposed of on-site while all other debris would be disposed of off-site, in accordance with Rhode Island Solid Waste Regulations. Material to be removed from the septic tank would be tested prior to its disposal. Based on the state's hazardous waste regulations, septage is a hazardous waste and must be disposed of in accordance with the hazardous waste regulations. In the event that testing indicates that the sludge from the septic tank is a hazardous waste, the disposal would have to adhere to LDRs. The inlets and outlets of both raceways would be sealed with a concrete barrier and then suitable backfill material would be placed in sections of the raceway that are not collapsed. Some of the raceway construction activities will occur within the floodplain of the Branch River as well as within an area defined as a wetlands by the State of Rhode Island. Therefore federal and state regulations regarding floodplains and wetlands will be important ARARs.

ESTIMATED TIME FOR CONSTRUCTION:	3 Months
ESTIMATED TIME FOR OPERATION:	3 Months
ESTIMATED CAPITAL COST:	$715,825
ESTIMATED O & M (Cost/Year):	$ 27,400
ESTIMATED TOTAL COST (Present worth):	$974,120

OS-4

Building Demolition, Sealing Raceways, Location and Excavation of Septic Tank, Excavation of PAH "Hot Spot", Site Grading

This alternative is identical to OS-3 with the addition of the excavation of contaminated raceway sediments and "hot spot" soils. It is estimated that 22 cubic yards of sediment would be excavated from both raceways prior to their being backfilled. The sediments would be tested and if they did exhibit a hazardous characteristic as defined by Rhode Island Hazardous Waste Regulations, they would be treated and disposed of off-site. Sampling and analysis of the "hot spot" area would be necessary to delineate the extent of soil contamination that would require excavation and treatment. The "hot spot" as described in Section V.B.3., of this document, is a localized area of PAH contamination. Although elevated levels of PAHs, as compared to background levels were found in the "hot spot", these levels were not found to pose a health risk to public health and the environment.

For cost estimation purposes, the volume of contaminated soils in this area was assumed to be 15 cubic yards. The exact amount will not be known until further sampling and analysis of the area is completed. The ultimate disposal of "hot spot" soils would be dependent upon analytical results, but would be in accordance with the appropriate State Solid Waste Regulations or Hazardous Waste regulations.

ESTIMATED TIME FOR CONSTRUCTION:	4 Months
ESTIMATED TIME FOR OPERATION:	4 Months
ESTIMATED CAPITAL COST:	$ 914,475
ESTIMATED O & M (Cost/Year):	$ 31,400
ESTIMATED TOTAL COST (Present worth):	$1,210,480

OS-5

No-action

This alternative is included in the FS, as required by CERCLA, to serve as a basis for comparison with the other management of migration alternatives being considered for the overall Site.

The no-action alternative would implement institutional controls on future land use to ensure that future development of the Site be limited to prevent future health and environmental risks. In addition, the fencing around the Site would be improved to provide a more effective barrier preventing entry of third parties onto the Site. This alternative would not prevent the migration of contaminants from the Site through the raceways into the Branch River and therefore the current risk to the public health and environment would continue.

ESTIMATED TIME FOR CONSTRUCTION:	2 Months
ESTIMATED TIME FOR OPERATION:	2 Months
ESTIMATED CAPITAL COST:	$ 42,510
ESTIMATED O & M (Cost/Year):	$ 8,000
ESTIMATED TOTAL COST (Present worth):	$116,930

IX. SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

Section 121(b)(1) of CERCLA presents several factors that at a minimum EPA is required to consider in its assessment of alternatives. Building upon these specific statutory mandates, the National Contingency Plan articulates nine evaluation criteria to be used in assessing the individual remedial alternatives.

A detailed analysis was performed on the alternatives using the nine evaluation criteria in order to select a site remedy. The following is a summary of the comparison of each alternative's strength and weakness with respect to the nine evaluation criteria. These criteria and their definitions are as follows:

Threshold Criteria

The two threshold criteria described below must be met in order for the alternatives to be eligible for selection in accordance with the NCP.

1. **Overall protection of human health and the environment** addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced or controlled through treatment, engineering controls, or institutional controls.

2. **Compliance with applicable or relevant and appropriate requirements (ARARS)** addresses whether or not a remedy will meet all of the ARARs of other Federal and State environmental laws and/or provide grounds for invoking a waiver.

Primary Balancing Criteria

The following five criteria are utilized to compare and evaluate the elements of one alternative to another that meet the threshold criteria.

3. **Long-term effectiveness and permanence** addresses the criteria that are utilized to assess alternatives for the long-term effectiveness and permanence they afford, along with the degree of certainty that they will prove successful.

4. **Reduction of toxicity, mobility, or volume through treatment** addresses the degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume, including how treatment is used to address the principal threats posed by the site.

5. **Short-term effectiveness** addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup goals are achieved.

6. **Implementability** addresses the technical and administrative

feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

7. **Cost** includes estimated capital and Operation Maintenance (O&M) costs, as well as present-worth costs.

Modifying Criteria

The modifying criteria are used on the final evaluation of remedial alternatives generally after EPA has received public comment on the RI/FS and Proposed Plan.

8. **State acceptance** addresses the State's position and key concerns related to the preferred alternative and other alternatives, and the State's comments on ARARs or the proposed use of waivers.

9. **Community acceptance** addresses the public's general response to the alternatives described in the Proposed Plan and RI/FS report.

A detailed narrative assessment of each alternative according to the nine criteria can be found in Section 5 of the FS on pages 5-4 through 5-82.

Following the detailed analysis of each individual alternative, a comparative analysis, focusing on the relative performance of each alternative against the nine criteria, was conducted. This comparative analysis can be found in Table 6-1 of the FS.

The section below presents the nine criteria and a brief narrative summary of the alternatives and their strengths and weaknesses according to the detailed and comparative analyses.

A. TCE Spill Area

1. Overall Protection of Human Health and the Environment

Alternatives TSA-1 and TSA-3 use technologies that will be protective of human health and the environment by treating the soil so that the mobility, toxicity and volume of contaminants will be reduced. Alternative TSA-1 uses excavation and incineration. TSA-3 uses in-situ soil vacuum extraction. Alternative TSA-4 is not protective because it proposes no-action.

Both alternatives TSA-1 and TSA-3 use treatment technologies which are effective in eliminating the principal threats found in the spill area, i.e., TCE and its breakdown products. Alternative TSA-1 would achieve the destruction of additional contaminants such as PAHs, which were found in the spill area at lower concentrations. The concentrations of PAHs found in the spill area were not found to present a risk to public health and the environment.

The time frame required to reach the soil remediation levels can be estimated with greater certainty for alternative TSA-1 than for alternative TSA-3. Excavation and incineration are two unit operations for which accurate time estimates are available. This information can be applied to the conditions at the Site to come up with an accurate estimate of the time required to reach the remediation levels for spill area soils. Alternative TSA-3, soil vacuum extraction, relies on the physical properties of the soil and the compounds being removed to estimate the remediation time frame. Therefore, the estimated cleanup time for TSA-3 is subject to greater uncertainty because the physical properties of the soil at the Site are non-homogeneous as a result of previous construction activities at the Site. In addition, many of the chemical properties important to vacuum extraction (i.e., Henry's constant) are either calculated or laboratory derived values and not necessarily representative of site-specific values. Furthermore, it is likely that not all areas of TCE spill soils would achieve cleanup levels at the same time using vacuum extraction, thereby requiring an extended and intermittent operation interspersed with a series of confirmation sampling rounds. Despite these uncertainties associated with TSA-3, the overall time frame for reaching remediation levels throughout the spill area is roughly equivalent for both alternatives, TSA-1 and TSA-3, and would take approximately 1 to 2.5 years.

Of the two treatment alternatives, TSA-3 carries the lesser risk to human health and the environment during construction and operation. Also, alternative TSA-3 would generate fewer waste streams and the one principal waste stream that it does generate, spent activated carbon, can be regenerated off-site and then reused. The fact that the spent carbon can be regenerated lessens the amount of hazardous waste generated by alternative TSA-3 which requires disposal. The principal waste stream produced by alternative TSA-1, bottom ash, may require treatment consistent with LDR requirements and disposal in a RCRA landfill.

2. <u>Compliance with ARARs</u>

Each alternative was evaluated for compliance with ARARs, including chemical-specific, action-specific, and location-specific ARARs. A description of these ARARs is presented in Tables 9 through 11 in Appendix B of this document. These tables list all potential ARARs identified for the Site and give brief synopses of the ARARs and explanations of the actions necessary to meet the ARARs. The tables also indicate whether the ARARs are applicable or relevant and appropriate to actions at the Site. Alternatives TSA-1 and TSA-3 meet their respective ARARs. Alternative TSA-3 is expected to have less impact on spill areas that are considered wetlands under the state definition and the least potential for affecting the water quality of the adjacent Branch River because of the limited excavation and construction activities that would take place. Alternative TSA-4 does not attain the following ARARs: Safe Drinking Water Act (SDWA) Maximum

Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs), Rhode Island Regulations Pertaining to Public Drinking Water (R46-13-DWS), Draft Groundwater Classification under the R.I. Groundwater Protection Act (R.I.G.L. 46-13.1), Clean Water Act Ambient Water Quality Criteria (AWQCs), and R.I. Water Quality Regulations for Water Pollution Control (RI GL 46-12).

3. **Long-Term Effectiveness and Permanence**

Alternatives TSA-1 and TSA-3 would be equally effective in treating and removing the residual TCE and its breakdown products from spill area soils. Incineration destroys the source of contamination. Soil vacuum extraction withdraws the source of contamination; the contaminants are later destroyed when the spent carbon is regenerated or disposed of. The levels of TCE and related VOCs left in spill area soils upon completion of either alternative would meet cleanup levels. Alternative TSA-3 would not produce a significant removal of other contaminant types, such as PAHs, although the levels at which the PAHs were found did not pose a significant risk to the public health and the environment. Both alternatives would provide for permanent and irreversible contaminant removal for the contaminants of concern, TCE and related VOCs. Alternative TSA-4 would not provide any long term protection of human health and the environment as the source of the groundwater contamination would be left in place without any type of treatment or containment.

4. **Reduction of Toxicity, Mobility, or Volume through Treatment**

Alternatives TSA-1 and TSA-3 would both achieve a reduction in the toxicity, mobility, and volume of contaminants in the soils of the TCE spill area. Both technologies use treatment as the means whereby contaminants are significantly and irreversibly reduced. The no-action alternative, TSA-4, provides no reduction in toxicity, mobility, or volume because no treatment is included.

5. **Short-Term Effectiveness**

The no-action alternative, TSA-4 would take the shortest time to complete, with an expected duration of 2 months. Alternative TSA-1 would take an estimated 1 to 2.5 years and alternative TSA-3 would take an estimated 1 year to achieve cleanup levels. With respect to protection of the community, the environment, and workers on-site, alternative TSA-3 poses the least potential for adverse impacts of the treatment options. The only potential impacts might result from the generation of dust during the installation of extraction wells. Air emissions from the vacuum extraction system would be treated through the use of vapor phase activated carbon. Although alternative TSA-1 also includes air pollution equipment to control air emissions, there would still be a large potential for air emissions during the excavation, separation, and processing of soils prior to incineration. Even with the use of strict engineering controls such as foaming agents to act as dust suppressants, the potential risks to the community and workers due to air emissions would be significant. In addition, the excavation of soil from the TCE spill area as part of alternative TSA-1 presents a potential environmental risk to the adjacent Branch River if soil were to be transported to the river by wind erosion or surface water runoff. Alternative TSA-4 would not present any potential risks to public health and the environment because it would not entail any remediation activities.

6. Implementability

Although all of the alternatives can be implemented, some alternatives are technically and administratively easier to implement than others, based on their simpler design and lack of complexity.

Of the two treatment alternatives, TSA-3, in-situ soil vacuum extraction, would be easier to implement. The installation of extraction wells and operation of extraction equipment require fewer engineering controls than excavation and incineration. TSA-3 also produces fewer waste streams. Therefore, fewer substantive requirements would have to be met by TSA-3. Although both technologies are available, the equipment needed for the installation and operation of the vacuum extraction system is easily acquired from many different sources and would require very little time to construct and have operating. The installation of the mobile rotary kiln incinerator is much more involved and there are a limited number of sources available for this type of equipment. Incineration would also require a test burn which might prevent the full-time operation of the equipment for a period of up to one year after initiating the test burn. Alternative TSA-4 would be easily implemented because the equipment for grading soil is readily available and this alternative would not have any administrative requirements.

There is more certainty in the time frame required by alternative TSA-1 to achieve the remediation levels than by TSA-3. Once the soil has been incinerated, remediation levels will have been reached. Soil vacuum extraction will require a series of confirmation soil samples interspersed between operational periods to make the determination of when remediation levels will have been reached. The sampling and operation of the vacuum extraction system will have to continue until remediation levels have been achieved throughout the spill area.

7. Cost

The estimated capital, O&M, and present worth values of each alternative are as follows:

COST COMPARISON OF TCE SPILL AREA ALTERNATIVES

		Capital Costs	O&M Costs ($/yr)	Present Worth
TSA-1	Excavation and Incineration	$9,994,150	100,000	10,690,620
TSA-3	Soil Vacuum Extraction	$266,465	1,500	280,605
TSA-4	No-action	$40,140	1,500	54,280

8. **State Acceptance**

The Rhode Island Department of Environmental Management (RIDEM) concurs with the selection of a soil vacuum extraction system as the source control alternative for the TCE spill area.

9. **Community Acceptance**

The comments received during the public comment period and the discussions during the Proposed Plan and FS public meeting are summarized in the attached document entitled "The Responsiveness Summary" (Appendix C). Varied comments were received from residents living near the Site and from officials representing the community and state. The residents indicated that they preferred a treatment alternative for the TCE spill area but did not declare a preference for one over the other.

B. Landfill Area

1. **Overall Protection of Human Health and the Environment**

Alternatives LA-1 and LA-3 use technologies that would be protective of human health and the environment. Alternative LA-1 uses excavation and incineration. LA-3 uses consolidation, capping, and leachate collection. Alternative LA-5 is not protective because it proposes no-action to address the response objectives of this area.

Alternative LA-1 provides the greatest long-term effectiveness by destroying the contaminants present in the landfill. However, short-term risks posed by air emissions during the materials handling and operational phases are judged to override the benefits of complete destruction. Alternative LA-3 provides protection from direct contact with contaminants, controls further downward and off-site migration of contaminants in the groundwater caused by precipitation and soil leachate, and minimizes dust erosion and surface runoff. However, capping does not reduce the toxicity of materials or provide the certainty of protection that incineration does.

2. Compliance with ARARs

Each alternative was evaluated for compliance with ARARs, including chemical-specific, action-specific, and location-specific ARARs. A description of these ARARs are presented in Tables 9 through 11 in Appendix B of this document. Alternatives LA-1 and LA-3 meet their respective ARARs.

Alternative LA-3 is expected to have the least impact on areas that are considered wetlands under the state definition and the least potential for affecting the water quality of the adjacent Branch River because the amount of excavation is limited to only those areas of the landfill in the 100-year floodplain. The volume to be excavated during LA-3 is roughly equivalent to five percent of the total landfill volume. Alternative LA-1 would require the excavation and processing of all of the landfill wastes. Since both alternatives would require the excavation of landfill wastes, both will require strict engineering controls to minimize any potential air emissions. In addition, both would require engineering controls to minimize potential releases of contaminants into the Branch River which would violate floodplain and wetlands ARARs. Alternative LA-5 does not attain the following ARARs: RCRA Landfill Closure Requirements (40 CFR 264, Subpart N), Rhode Island Rules and Regulations for Solid Waste Management Facilities (R.I.G.L. 23-18.9, 23-19, 42-17.1), Clean Water Act Ambient Water Quality Criteria (AWQCs), and R.I. Water Quality Regulations for Water Pollution Control (RI GL 46-12).

3. Long-Term Effectiveness and Permanence

Alternative LA-1 is the treatment option considered for the landfill area. Incineration destroys the source of contamination but also produces a residual ash composed mainly of inorganic elements which requires disposal. The residual ash may, upon testing, exhibit a hazardous waste characteristic and therefore require treatment consistent with LDRs (e.g., solidification) and disposal in a RCRA landfill. Alternative LA-1 has a higher degree of certainty associated with the permanence of the technology versus alternative LA-3. Once the wastes have been destroyed by incineration the remediation levels will have been met.

Under the capping alternative, LA-3, the risk of direct contact and the risk of release into the environment would be minimized for as long as the physical integrity of the cap were maintained. Capping would provide for long-term effectiveness by meeting RCRA closure requirements. However, the design life of a cap is subject to some uncertainty. While proper installation and maintenance will extend the cap's life significantly, cap replacement may be necessary at some time in the future. A long term monitoring program, such as the one included as part of LA-3, would provide sufficient warning of a potential cap failure. Alternative LA-5, the no-action alternative, provides very little, if any, long-term effectiveness and permanence.

4. Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives LA-1 is the only alternative that provides for the reduction of toxicity, mobility, and volume of landfill wastes through treatment. In addition, the incineration process provides for the greatest reduction of toxicity, mobility, or volume of landfill wastes of all the alternatives considered for the landfill. A potential drawback for the incineration process is that it produces a residual ash which may require further treatment to assure that the toxicity and mobility of the ash are reduced to a level which are protective of human health and the environment.

Alternative LA-3 would achieve a reduction in the mobility of contaminants in the landfill but does not use treatment to achieve this reduction. Capping will limit the infiltration of precipitation and control leaching of contaminants into the groundwater as well as the surface migration of contaminants into the Branch River. The no-action alternative, LA-5, provides no reduction in toxicity, mobility, or volume since no treatment or containment is included.

5. Short-Term Effectiveness

The no-action alternative, LA-5, would be completed in the shortest time, with an expected duration of 2 months. Alternative LA-1 would take an estimated 2.5 to 3 years and alternative LA-3 would take an estimated 6 months to achieve cleanup levels. With respect to protection of the community, the environment, and workers on-site, alternative LA-3 poses the least potential for adverse impacts. A potential impact of this alternative may be air emissions and the generation of dust during the excavation of landfill wastes located in the 100-year floodplain.

Although alternative LA-1 includes air pollution equipment to control air emissions, there would still be a potential for air emissions during the excavation, separation, and processing of soils prior to incineration. Even with the use of strict engineering controls the potential risks to the community and workers due to air emissions would be significant. Alternative LA-5 would not present any potential risks to public health and the environment because it would entail only minimal risk of contaminated fugitive dusts being generated and carried off-site during site grading activities.

6. Implementability

Although all of the alternatives can be implemented, some alternatives are technically and administratively easier to implement than others, based on their simpler design and lack of complexity.

Of all the three alternatives, the no-action alternative, LA-5, would be the easiest to implement since there are only a limited number of activities to be conducted. The equipment needed for grading soil as described in the no-action alternative is readily available and this alternative would not have any administrative requirements. Of the two alternatives which would achieve the response objectives for the landfill area, LA-3 is simpler to implement. Capping has been used on other Superfund sites and is not difficult to design and construct. Capping would require the use of institutional controls to limit further land use of the area. The capping alternative would also produce fewer waste streams than incineration. Therefore, fewer substantive requirements would have to be met. Although the expertise and equipment for both capping and incineration is available, the number of sources of available mobile rotary kiln vendors are more limited. In addition, prior to full operation of the rotary kiln a test burn would be necessary to assure the efficiency of the equipment in destroying Site-specific contaminants and determine optimum operating conditions. The procedures and requirements necessary for a successful test burn could postpone the full-time operation of the equipment at the Site for up to one year.

7. Cost

The estimated capital, O&M, and present worth value of each alternative are as follows:

COST COMPARISON OF LANDFILL AREA ALTERNATIVES

		Capital Costs	O&M Costs ($/yr)	Present Worth
LA-1	Excavation and Incineration	$17,960,700	100,000	18,815,840
LA-3	Consolidation and Capping	$587,750	62,000	1,172,000
LA-5	No-action	$30,140	18,500	204,540

8. State Acceptance

The Rhode Island Department of Environmental Management (RIDEM) would have preferred excavation and off-site disposal of the material found in the landfill. However, the Department understands the uncertainty as to whether any or all of that material is actually hazardous waste and, if so, the corresponding difficulty and expense in disposing of those materials.

RIDEM concurs with the selection of a multi-layer cap and leachate collection system, with institutional controls in place, as the source control alternative for the landfill area. RIDEM cannot unilaterally impose the institutional controls necessary to protect the integrity of the landfill.

9. Community Acceptance

The comments received during the public comment period and the discussions during the Proposed Plan and FS public meeting are summarized in the attached document entitled "The Responsiveness Summary" (Appendix C). Varied comments were received from residents living near the Site and from officials representing the community and state. The residents indicated that they preferred a treatment alternative for the Landfill area which permanently remediates the material there and eliminates any future risks and expressed a preference for the excavation and removal of landfill wastes to an off-site location.

C. Groundwater Extraction and Treatment

1. Overall Protection of Human Health and the Environment

Alternatives GW-1, GW-2, and GW-4 use treatment technologies that will be protective of human health and the environment by reducing the concentration of TCE and other VOCs found in the groundwater to below the drinking water standards. The technologies used for alternatives GW-1 and GW-2, air stripping and GAC, have a long proven history for effectively treating TCE and other VOCs. Alternative GW-4 is considered an innovative technology and has a more limited history of full-scale applications. Alternative GW-5, the no-action alternative, is not protective because it would not reduce the concentration of TCE and other VOCs found in the groundwater.

Alternative GW-4, utilizing the ultraviolet (UV) light and hydrogen peroxide system, provides the greatest long-term effectiveness by destroying the contaminants present in the groundwater without producing any residuals requiring treatment. Alternatives GW-1 and GW-2 both produce spent activated carbon which is a hazardous waste and requires treatment prior to disposal.

The UV/hydrogen peroxide technology also has the ability to effectively treat additional contaminants which may be found in the groundwater including the breakdown products of TCE, such as vinyl chloride. The importance of the potential presence of vinyl chloride is that both alternatives GW-1 and GW-2 use activated carbon and activated carbon is not effective for the treatment of vinyl chloride. During the RI, vinyl chloride was detected in only a few groundwater samples and at very low concentrations. At this time it is not known whether the natural transformation of TCE into vinyl chloride, which occurs in groundwater, will cause vinyl chloride to become a contaminant of concern in the groundwater at the Site. In the event that vinyl chloride is found in the groundwater at higher concentrations in the future, alternative GW-4, treatment by UV light and hydrogen peroxide, would provide the greatest protection and effectiveness in treating vinyl chloride to cleanup levels. Alternatives GW-2 and GW-4 have been shown to be effective in treating dieldrin which was also found at very low levels in a limited number of groundwater monitoring wells at the Site. GW-1 would not be effective in removing dieldrin from the groundwater.

2. Compliance with ARARs

Each alternative was evaluated for compliance with ARARs, including chemical-specific, action-specific, and location-specific ARARs. A description of these ARARs are presented in Tables 9 through 11 in Appendix B of this document. Alternatives GW-1, GW-2, and GW-4 all meet their respective ARARs. Alternative GW-1 would have to meet the greatest number of substantive requirements because of the air emissions and the production of two waste streams which would be considered hazardous wastes. These two hazardous waste streams would consist of spent activated carbon generated during the treatment of air emissions and polishing of the groundwater prior to its discharge.

Based upon the information presented in the RI and FS, which includes a laboratory-scale treatability study for alternative GW-4, all three treatment alternatives are expected to achieve cleanup levels which would meet drinking water standards as well as discharge limitations for all of the disposal options being considered for the treated groundwater. The disposal options being considered include discharge to the Branch River, discharge to a sewer line on-site, and subsurface discharge to a leaching field. Pilot testing of the groundwater treatment alternative selected will be necessary to assure that cleanup level ARARs and groundwater disposal ARARs can be met. Alternative GW-5, the no-action alternative, does not attain the following ARARs: SDWA MCLs and MCLGs, Rhode Island Regulations Pertaining to Public Drinking Water (R46-13-DWS), and the Draft Groundwater Classification under the R.I. Groundwater Protection Act (R.I.G.L. 46-13.1).

3. Long-Term Effectiveness and Permanence

Alternative GW-1, GW-2, and GW-4 would all achieve the groundwater response objectives and essentially the same level of cleanup. Air stripping and GAC are proven technologies for the removal of VOCs such as TCE. UV/hydrogen peroxide is an innovative technology which has only in the last few years been used for this type of application. Full-scale operating systems using the UV/hydrogen peroxide technology have been shown to be very effective in destroying VOCs such as those found at the Site. In addition, a bench-scale laboratory study was completed using groundwater from the Site and this demonstrated that the UV/hydrogen peroxide system could destroy site-specific contaminants to below cleanup levels in approximately three minutes. Alternative GW-4 also has the flexibility for effectively treating TCE breakdown products such as vinyl chloride which may form over time in the groundwater as a result of natural biological processes. Alternatives GW-1 and GW-2 would not be effective in removing vinyl chloride and might not be able to achieve cleanup levels for this compound. Alternatives GW-2 and GW-4 would be effective in removing and treating dieldrin, a pesticide found at very low concentrations in a few monitoring wells at the Site.

Alternatives GW-1 and GW-2 both produce spent carbon which is a hazardous waste and will require further treatment before disposal or reuse. The only known byproducts of alternative GW-4 are carbon dioxide, water and small quantities of free chloride ions (which combine with other minerals in the groundwater to form very small quantities of simple salts). Alternative GW-5, the no-action alternative, provides very little, if any, long-term effectiveness and permanence.

4. Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives GW-1, GW-2, and GW-4 would all achieve comparable reductions in the toxicity, mobility, and volume of contaminants found in the groundwater. The one exception to this is that alternatives GW-1 and GW-2 are not effective in removing vinyl chloride. The concentrations of vinyl chloride found in the groundwater at the Site, may increase with time as a result of natural biological processes. Therefore alternatives GW-1 and GW-2 would not effectively provide for the reduction of toxicity, mobility, or volume of all known and potential contaminants at the Site. GW-4, however, can effectively treat and reduce the toxicity, mobility, and volume of vinyl chloride.

Alternatives GW-1 and GW-2 both treat the groundwater by transferring the contaminants from the water to activated carbon and, as a result, both alternatives produce a waste residue of spent carbon. The spent carbon would be transported off-site for treatment and disposal. During treatment the majority of spent carbon is regenerated for reuse. The carbon that cannot be reused requires disposal. Alternative GW-4 is the only alternative which directly destroys the contaminants and therefore does not produce any waste residues requiring treatment. The no-action alternative, GW-5, provides no reduction in toxicity, mobility, or volume since no treatment is included.

5. Short-Term Effectiveness

The estimated time frames for cleaning up the groundwater for alternatives GW-1, GW-2, and GW-4 are all approximately 10 to 15 years. The no-action alternative, GW-5, would require an estimated 70 to 175 years to achieve cleanup, assuming removal of the source of contamination (i.e., TCE contaminated soils), and an estimated 300 years if the source were not removed.

EPA is aware that the subsurface conditions found at the Site (e.g., fractured bedrock) present inherent difficulties that may affect achieving the cleanup of the groundwater in the time frame estimated for all treatment alternatives. In addition the presence of high concentrations of TCE which may be indicative of DNAPL, further exacerbates the difficulty in predicting the cleanup time frame. Therefore, the cleanup time frames proposed may be subject to revision upon completing a thorough review of the performance of the treatment system, five years after the start up of the system.

All three treatment alternatives would generate a small amount of dust during the construction phase and thereby present a minimal risk to the community and workers on-site. Alternative GW-1 has the potential risk of air emissions. Alternatives GW-1 and GW-2 both generate spent carbon which is a hazardous waste. Alternative GW-4 uses hydrogen peroxide as one of its treatment components; this compound is a strong oxidizer. Proper storage and handling of hydrogen peroxide will reduce the risk to on-site workers. The risks to people off-site due to an on-site release is expected to be minimal. Alternative GW-5 would not present any potential risks to public health and the environment because it would not entail any remediation activities (but as true of all the no-action alternatives, it would also not eliminate any of the potential risks that already exist).

6. Implementability

Although all of the alternatives can be implemented, some alternatives are technically and administratively easier to implement than others, based on their simpler design and lack of complexity.

The two major questions regarding implementability relate to the design of the extraction system and unknowns associated with the effectiveness of the extraction system in achieving the cleanup levels in the estimated time frame. The predesign pump test will help provide the details needed to effectively design the extraction system. The implementability and effectiveness of the extraction system will only be known once the system is operating and its progress can be monitored.

Of all the alternatives, the no-action alternative, GW-5, would be the easiest to implement since the only activity to take place would be quarterly sampling of selected existing monitoring wells. For the three treatment alternatives, off-the-shelf equipment is readily available. Unforseen technical problems associated with the use of alternatives GW-1 and GW-2 are anticipated to be minimal since these technologies are well proven. Alternative GW-4 is an innovative technology and does not have a long operational history for this type of application. Therefore, there may be a greater number of unforseen technical problems. However, the UV/hydrogen peroxide technology has been used in the last few years at sites with similar types of contaminants and it has been shown to be very effective and reliable in destroying the contaminants to cleanup levels this Record of Decision requires. To insure the implementability of the alternative chosen, a pilot test would be conducted in conjunction with the on-site pump test as part of predesign activities.

GW-4 has the fewest administrative requirements to meet of the treatment options because it does not produce any air emissions as GW-1 does or any hazardous wastes as both GW-1 and GW-2 do.

7. Cost

The estimated capital, O&M, and present worth value of each alternative are as follows (the cost of extraction is the same for each alternative and is also included in the total cost):

COST COMPARISON OF GROUNDWATER TREATMENT ALTERNATIVES

	Capital Costs	O&M Costs ($/yr)	Present Worth
GW-1 Air Stripping	$1,537,140	139,525	3,190,010
GW-2 Granular Activated Carbon	$1,789,425	114,225	3,262,792
GW-4 UV/hydrogen Peroxide	$705,890	73,500	1,889,760
GW-5 No-action	$6,850	46,200	442,372

8. State Acceptance

The Rhode Island Department of Environmental Management (RIDEM) concurs with the selection of a UV/hydrogen Peroxide treatment system as the management of migration alternative for the groundwater. It is estimated that this alternative should achieve the cleanup levels after ten to fifteen years of operation. The Department is concerned, however, with the uncertainties associated with the technical feasibility and associated costs of achieving drinking water standards in a bedrock aquifer at the Site. RIDEM has emphasized, as specified in this Record of Decision, that periodic reviews be conducted to evaluate the performance of the system and, the feasibility and cost effectiveness of continued operation of the system in achieving the clean up levels. Revisions to the remedy should be made as necessary.

9. Community Acceptance

The comments received during the public comment period and the discussions during the Proposed Plan and FS public meeting are summarized in the attached document entitled "The Responsiveness Summary" (Appendix C). Varied comments were received from residents living near the Site and from officials representing the community and state. The residents indicated that they preferred a treatment alternative for the groundwater but did not declare a preference for one over the other.

D. Overall Site

1. Overall Protection of Human Health and the Environment

Alternatives OS-3 and OS-4 use technologies that will be protective of human health and the environment. Alternative OS-4 affords the most effective long-term protection by addressing the "hot spot" and sediment from the raceways. Alternative OS-4 also poses the greatest short-term risks to human health and the environment because of the potential for generating dust and air emissions during the excavation of these same materials.

Alternatives OS-3 and OS-4 would both significantly reduce the risks posed to on-site workers by reducing the physical hazards at the Site. OS-3 and OS-4 would eliminate a known migration pathway for contaminants from the Site to the Branch River by sealing and filling the raceways. They would both eliminate a potential source of groundwater contamination by removing the contents of the on-site septic tank and treating and disposing of the contents off-site. The primary difference between these two alternatives is that OS-4 includes the excavation of "hot spot" soils and sediment from the raceways. Although OS-4 includes the removal of "hot spot" soils, the concentrations of PAHs detected there were below levels which would pose a significant risk to public health and the environment but were considered elevated as compared to other background areas of the Site. Alternative OS-5 is not protective since it would not prevent further migration of contaminants from the Site into the Branch River via the raceways. It would also not remove the physical hazards existing at the Site. Until the physical hazards existing at the Site were removed, workers could not safely perform other activities of the remedy, which include addressing the landfill, spill area, and groundwater.

2. Compliance with ARARs

Each alternative was evaluated for compliance with ARARs, including chemical-specific, action-specific, and location-specific ARARs. A description of these ARARs are presented in Tables 9 through 11 in Appendix B of this document.

Alternatives OS-3 and OS-4 include remedial activities in the 100-year floodplain of the Branch River and in an area designated as a wetlands by the RIDEM. Excavated "hot spot" soils and raceway sediments may be a hazardous waste as defined by state and federal regulations. Originally it was proposed in the FS to combine the materials excavated from the "hot spot" and raceways with landfill wastes since they both exhibit similar chemical characteristics. Because this would not comply with Rhode Island Rules and Regulations for Hazardous Waste Generation, Transportation, Storage, and Disposal, the excavated material will have to be disposed of off-site in accordance with federal and state ARARs. All debris which is disposed of on-site would be done so in accordance with Rhode Island Solid Waste Regulations. Both OS-3 and OS-4 will meet their respective ARARs.

Alternative OS-5, the no-action alternative, does not attain the Clean Water Act Ambient Water Quality Criteria (AWQCs), and R.I. Water Quality Regulations for Water Pollution Control (RI GL 46-12). In addition, the selection of the no-action alternative would hinder the implementation of other source control and management of migration alternatives because of the dangers associated with the partially standing structures at the Site. These structures, which includes the smokestack, could collapse on workers implementing remediation activities in the spill area and landfill area. Therefore, workers could not safely work in these areas until the physical hazards associated with the on-site structures were eliminated.

3. Long-Term Effectiveness and Permanence

Alternative OS-4 would provide the greatest long-term effectiveness by removing and treating the contaminated materials from the "hot spot" and raceways, removing the physical site risks, and sealing of the raceways. As a result of the excavation of materials taking place under this alternative, hazardous materials will be generated and will require treatment and disposal. Depending on the treatment technology used for the excavated materials, a waste residue may be produced requiring further treatment prior to disposal.

Alternative OS-3 would achieve the same degree of long-term effectiveness as OS-4 in protecting public health and the environment even though OS-3 does not remove "hot spot" soils and sediment from the raceways. The levels at which PAHs were found in "hot spot" soils did not pose a risk to public health and the environment. The risk posed by sediments entering the Branch River would be eliminated in OS-3 by the sealing and filling of the raceways and therefore the removal of the sediments in OS-4 would not provide a greater degree of protection. As one of the remedial activities proposed for both OS-3 and OS-4, the location of the septic tank will be pinpointed and its contents removed, tested, treated, and disposed of. The exact location of the septic tank is unknown although it is believed to be under one of the existing debris piles. Therefore, the chemical nature and quantity of its contents still needs to be determined. Alternative OS-5 would not be effective in removing the known risks posed by contaminants migrating into the Branch River through the raceways and the potential risks due to the contents of the septic tank impacting the groundwater. In addition the no-action alternative does not eliminate the physical hazards presented by the partially standing buildings, deteriorating smokestack and numerous holes scattered throughout the Site. These physical hazards would increase with time as the standing structures continue to deteriorate and would prevent the implementation of construction activities for other aspects of the Site remedy.

4. Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative OS-4 would reduce the toxicity, mobility, and volume of contaminants from the "hot spot" and raceways. The extent of reduction would be dependent on the treatment method used for the excavated materials. Alternative OS-3 would achieve a reduction of mobility of contaminants through the raceways but this would be through containment rather than treatment. Both alternatives would reduce the toxicity, mobility, and volume of potential contaminants in the septic tank through treatment. Alternative OS-5 provides no reduction in toxicity, mobility, and volume since no treatment is included.

5. **Short-Term Effectiveness**

The no-action alternative, OS-5, would be completed in the shortest time (2 months). Alternative OS-3 would take an estimated 3 months and alternative OS-4 would take an estimated 4 months to achieve remediation objectives. With respect to protection of the community, the environment, and workers on-site, alternative OS-5 poses the least potential for adverse impacts since no remedial activities would take place. Of the two treatment alternatives, OS-3 would have less impact during construction and implementation because of the limited excavation activities. OS-3 would not excavate the "hot spot" soils or raceway sediments and therefore would not have the same potential as OS-4 to generate dust and air emissions during these activities. There would be potential air emissions associated with materials removed from the septic tank under alternatives OS-3 and OS-4.

Both alternatives OS-3 and OS-4 would generate noise, heavy equipment traffic, and particulate emissions during the demolition and removal of structures and the filling of the raceways. The investigations to date have not included explorations into or beneath existing structures because of health and safety concerns. Therefore, there remains a lack of certainty of what may be encountered during the demolition of the structures and what potential releases, if any, may occur and effect the community, workers on-site, and the environment.

6. **Implementability**

While all of the alternatives can be implemented, some alternatives are technically and administratively easier to implement than others, based on their simpler design and lack of complexity.

Of all the alternatives, the no-action alternative, OS-5, would be the easiest to implement since there are no remedial activities to be conducted other than improvements to the fencing. Alternatives OS-3 and OS-4 are both technically implementable but OS-4 would be the more complicated of the two with the additional excavation activities required for the "hot spot" and raceway sediments. The demolition of the partially standing building and smokestack will require the services of experts to minimize any potential impacts to nearby residents. Based on administrative implementability, the most significant difference between the treatment alternatives is the additional substantive requirements that will be necessary for the disposal of excavated materials under OS-4. Both alternatives will have activities occurring in designated state wetlands of the Branch River and will have to meet the substantive requirements of the Rhode Island Wetlands Protection Act. In addition, both alternatives OS-3 and OS-4 would require the implementation of institutional controls to control future land use over the raceways, and buildings.

7. Cost

The estimated capital, O&M, and present worth value of each alternative are as follows:

COST COMPARISON OF OVERALL SITE ALTERNATIVES

	Capital Costs	O&M Costs ($/yr)	Present Worth
OS-3 Demolition, Sealing Raceways, Septic Tank, and Site Grading	$715,825	27,400	974,120
OS-4 Demolition, Sealing Raceways, Septic Tank, "Hot Spot" Excavation, and Site Grading	$914,475	31,400	1,210,480
OS-5 No-action	$42,510	8,000	116,930

8. State Acceptance

The Rhode Island Department of Environmental Management (RIDEM) concurs with the selection of the combination of demolition of the remaining structures on the Site, sealing of the remaining raceways, location and removal of the septic tank, and final site grading as the management of migration alternative for the overall Site. The department has raised concerns about the potential routes of migration through the sewer line trench and through potentially uncollapsed sections of the raceway underneath the landfill. This issue will be further evaluated during the predesign, design, and operation of the remedy.

9. Community Acceptance

The comments received during the public comment period and the discussions during the Proposed Plan and FS public meeting are summarized in the attached document entitled "The Responsiveness Summary" (Appendix C). Varied comments were received from residents living near the Site and from officials representing the community and state. The residents voiced very strong concerns over the present physical conditions of the Site and indicated that they wanted the physical hazards which have existed there for years addressed as quickly as possible. However, they did not indicate a preference for which alternative they thought should be used to accomplish the overall Site cleanup.

X. THE SELECTED REMEDY

EPA has selected a comprehensive remedy consisting of the following alternatives to address the different remedial areas identified at the Stamina Mills Site:

TCE Spill Area

TSA-3: Soil Vacuum Extraction;

Landfill Area

LA-3: Capping Including Consolidation;

Groundwater Treatment

GW-4: Ultraviolet Light and Hydrogen Peroxide; and

Overall Site

OS-3: Building Demolition, Sealing and Filling of Raceways, Location of Septic Tank and Removal of Contents, and Site Grading.

EPA believes this remedy is comprehensive as it contains both source control and management of migration components which use treatment to address the principal threats and engineering controls to address relatively low long-term threats identified at the Site. A detailed description of the cleanup levels and the selected remedy is presented below.

A. Cleanup Levels

Cleanup levels have been established for contaminants of concern identified in the baseline risk assessment found to pose an unacceptable risk to either public health or the environment. Cleanup levels have been set based on the appropriate ARARs (e.g., Drinking Water MCLGs and MCLs) if available. In the absence of a chemical-specific ARAR, or other suitable criteria to be considered, a 10^{-6} excess cancer risk level for carcinogenic effects or a concentration corresponding to a hazard index of one for compounds with non-carcinogenic effects was used to set cleanup levels. In instances in which the values described above were not feasible to quantify, the limit that could be reliably measured by analytical methods was used as the cleanup level. Periodic assessments of the protection afforded by remedial actions will be made as the remedy is being implemented and at the completion of the remedial action. If the remedial action is not found to be protective, further action shall be required.

1. Groundwater

Because the aquifer at and beyond the compliance boundary of the Site is a current source of drinking water (i.e., it is classified as Class

II, Subclass IIA) MCLs and non-zero MCLGs established under the Safe Drinking Water Act are ARARs. The compliance boundary established for groundwater cleanup levels is throughout the contaminated groundwater plume from the boundary of the waste management area on-site to the edge of the plume off-site. Cleanup levels will be achieved in each compliance monitoring well located at or beyond the compliance boundary. The waste management area for the Site is defined as those areas of the Site where wastes will be contained in place and includes the area delineated by the landfill, raceways, and building structures to be demolished.

Cleanup levels for known and probable carcinogenic compounds (Class A & B) have been set at the appropriate MCL because the MCLG for these compounds is generally set at zero. Cleanup levels for the Class C compounds (possible carcinogens), Class D (not classified) and Class E (no evidence of carcinogenicity) have been set at the MCLs. When appropriate (e.g., the cumulative risk is greater than 10^{-4} or the hazard index is greater than 1), the cleanup levels have been set up at non-zero MCLGS if MCLGs are more stringent than MCLs. In the absence of a MCLG, a MCL, a proposed drinking water standard or other suitable criteria to be considered (i.e. health advisory, state standard), a cleanup level was derived for carcinogenic effects based on a 10^{-6} excess cancer risk level considering the ingestion of groundwater.

Cleanup levels for compounds in groundwater exhibiting non-carcinogenic effects have been set at the MCLG. In the absence of a MCLG, a MCL, a proposed drinking water standard or other suitable criteria to be considered (i.e. health advisory, state standard), cleanup levels for non-carcinogenic effects have been set at a level thought to be without appreciable risk of an adverse effect when exposure occurs over a lifetime (hazard index = 1). The hazard index is calculated by dividing the exposure level by the reference dose (RfD) or other suitable benchmark for non-carcinogenic health effects. Reference doses have been developed by EPA to protect sensitive individuals over the course of a lifetime. They reflect a daily exposure level that is likely to be without an appreciable risk of an adverse health effect.

Table I below summarizes the cleanup levels for carcinogenic and non-carcinogenic contaminants of concern identified in groundwater.

TABLE 1: GROUNDWATER CLEANUP LEVELS

Carcinogenic Contaminants of Concern	Cleanup Level (ppb)	Basis	Level of Risk
Trichloroethylene	5	MCL	$2x10^{-6}$
Tetrachloroethylene	5	PMCL(1)	$7x10^{-6}$
1,1-Dichloroethylene	7	MCL	$1x10^{-4}$
Vinyl Chloride	2	MCL	$1x10^{-4}$

Non-Carcinogenic Contaminants of Concern	Cleanup Level (ppb)	Basis	Target Endpoint of Toxicity	Hazard Index
1,2-Dichloroethylene	70	PMCL	Liver	0.2
Tetrachloroethylene	5	PMCL	Liver	0.01
Dieldrin	2	HA(2)	Liver	1.0
Chromium	50	NIPDWR(3)	Liver	0.2

(1) Proposed Maximum Contaminant Level
(2) Health Advisory
(3) National Interim Primary Drinking Water Regulation

These cleanup levels must be met at the completion of the remedial action at the compliance boundary, which as described earlier, is throughout the contaminated groundwater plume, from the boundary of the waste management area on-site to the edge of the plume off-site. Cleanup levels will be achieved in each compliance monitoring well located at or beyond the compliance boundary. The waste management area for the Site is defined as those areas of the Site where wastes will be contained in place and includes the area delineated by the landfill, raceways, debris piles, and building structures to be demolished.

The location and number of compliance monitoring wells will be finalized during design; however, at a minimum, a subset of existing on-site and off-site wells will be selected and may include the installation of additional monitoring wells. The type and frequency of monitoring will also be finalized during design. Sampling parameters will include the following: the target compound list (TCL) volatile organic compounds, the target analyte list for metals, dieldrin, pH, temperature, specific conductance, and chloride. Specific parameters may be added or deleted depending on sampling results and observed trends. EPA has estimated that these levels will be obtained within 10 to 15 years. Once the cleanup levels have been obtained, the extraction wells will be shut down and a monitoring program will be implemented to confirm the results. This program will, at a minimum, consist of three years of quarterly monitoring of groundwater quality.

These cleanup levels are consistent with ARARs for groundwater and will attain EPA's risk management goal for remedial actions. The cleanup levels for vinyl chloride and 1,1-dichloroethylene have been set at the MCL and MCLG respectively, which is the lowest levels that can be analytically quantified and therefore the lowest levels that can be practically set. Given the effectiveness of the groundwater treatment process for destroying chlorinated solvents and the relatively low concentrations of both vinyl chloride and 1,1-dichloroethylene as compared to TCE, the primary contaminant of concern, EPA believes that the levels of both of these compounds in treated groundwater will be below cleanup levels.

It should be noted that the levels of chromium detected in the groundwater at the Site did not exceed the target cleanup level shown in Table I with the exception of one well in the landfill. As described in Section V.C., of this Record of Decision, chromium levels which did exceed the cleanup level were obtained from what is believed to be landfill leachate. Since the remedy for the Site includes a leachate collection system, EPA believes that target cleanup levels for chromium will be met without the need for additional groundwater treatment. Levels of chromium and other trace metals found in the groundwater will be monitored during the predesign activities, which includes a pump test and pilot testing of the groundwater treatment system, to determine if any additional treatment of metals will be necessary to meet cleanup levels and groundwater disposal requirements. In addition, an environmental monitoring program, which will involve the sampling of sediment and surface water from the Branch River, will be developed during the remedial design phase to assure that the response objectives of the landfill area will be met.

2. Soil Cleanup Levels

Cleanup levels in soils were established in order to protect human health, the environment, and the aquifer below the Stamina Mills Site from contamination. The Summers Model was used to estimate residual soil levels that are not expected to impair future groundwater quality. ARARs for the groundwater (MCLGs and MCLs) were used as inputs into the leaching model. In the absence of an ARAR, the level corresponding to a 10^{-6} risk level (for carcinogens) or a hazard index of one (non-carcinogenic effects) was utilized. If the cleanup values described above were not capable of being detected or were below regional background values, then either the CRQL or a background value was substituted. Partitioning coefficients, and additional inputs to the leaching model, were either laboratory derived (as in the case of TCE) or obtained from EPA guidance documents. Table 2 summarizes the soil cleanup values for the contaminants of concern developed to protect public health, the environment, and the aquifer.

TABLE 2: SOIL CLEANUP LEVELS

Carcinogenic Contaminants of Concern	Soil Cleanup Level (ug/kg)	Basis for Model Input	Residual Groundwater Risk
Trichloroethylene	195	MCL	$2x10^{-6}$
Tetrachloroethylene	66	PMCL	$7x10^{-6}$
1,1-Dichloroethylene	17	MCL	$1x10^{-4}$

Non-Carcinogenic Contaminants of Concern	Soil Cleanup Level (ug/kg)	Basis for Model Input	Target Endpoint Toxicity	Residual Groundwater Hazard Index
1,2-Dichloroethylene	151	PMCL	Liver	0.2

Soil cleanup levels were not established for dieldrin and chromium because theses compounds were only detected at elevated levels in the landfill wastes which are to be consolidated and capped in place as part of the remedy selected for this Site. Soil cleanup levels were also not established for vinyl chloride because this compound was not detected in any soil samples obtained at the Site during the RI. Monitoring of the cleanup levels in the TCE spill area soils will include the analysis for vinyl chloride. In the event that vinyl chloride is detected during the monitoring, a soil cleanup level will be established using the Sommers Model and the same procedures used for calculating the soil cleanup levels shown above.

These cleanup levels in soils are consistent with ARARs for groundwater and attain EPA's risk management goal for remedial actions of 10^{-4} to 10^{-6} and a hazard index of less than one. Furthermore, these soil levels should be protective of any potential health risks posed by direct contact or incidental ingestion of the soils.

These cleanup levels must be met at the completion of the remedial action throughout the contaminated soils in the TCE spill area and which are located above the bedrock aquifer. The location and number of compliance monitoring points and the sampling procedures by which cleanup levels are to be demonstrated will be developed during the design. EPA has estimated that cleanup levels will be achieved within one year.

B. Description of Remedial Components

The following is a list of the major components of the remedy:

1. In-situ vacuum extraction of TCE spill area soils;
2. Excavation of landfill wastes from 100-year floodplain and consolidation with landfill wastes above floodplain;
3. Installation of leachate collection system in landfill;
4. Capping of the landfill;
5. Groundwater extraction and treatment using UV/hydrogen peroxide system;
6. Demolition of on-site structures;
7. Sealing and backfilling of raceways;
8. Location of septic tank, testing and removal of contents, and off-site treatment and/or disposal;
9. Grading of Site;
10. Long-term environmental monitoring; and
11. Institutional controls.

The in-situ soil vacuum extraction system will consist of a number of shallow wells installed to a depth of approximately 10 feet, or far enough above the water table to avoid the extraction of excess moisture. These wells are connected to a vacuum pump which pulls air and VOCs with it through and from the soil. The air containing VOCs is then treated with activated carbon filters before it is discharged to the atmosphere. Water vapor is sometimes withdrawn from the soil along with VOCs and if a collectable quantity is formed it will be combined with extracted groundwater and treated accordingly. During the design phase, the number, depths, and locations of extraction wells will be finalized. It is expected that these design details as well as the optimum operating conditions can be provided through the initial pilot-testing of a full-scale unit. Periodic review and modification of the design, construction, maintenance, and operation of the soil vacuum extraction system may be necessary over time. A frequency for reviewing the progress of the system for meeting the goals and design criteria will be established during the design phase.

Approximately 550 cubic yards of a mixture of landfill wastes and sediments will be excavated from the 100-year floodplain of the Branch River. This material will be redeposited above the floodplain onto the existing landfill area before the new cap is installed. As described in Section XI.B.3., of this Record of Decision, EPA does not believe these activities constitute placement because of the contiguous nature of the materials being excavated. They therefore are not subject to LDRs. During the excavation of the wastes in the floodplain as well as the grading and stabilization of landfill slopes adjacent to the Branch River, appropriate engineering controls will be used to minimize the migration of landfill wastes into the river as well as to control odors and air emissions. Upon completion of excavation, a leachate collection system will be installed along the toe of the landfill on its southern side.

EPA believes that the installation of a leachate collection system and capping of the landfill will address the release of trace metals into the Branch River and the groundwater. During the RI low levels of trace metals were detected in monitoring wells near the landfill area and one compound, chromium, exceeded drinking water standards. The two wells in which chromium levels exceeded drinking water standards are screened over intervals which are above the bedrock aquifer but are in direct contact with landfill wastes. Therefore, the water being sampled in these shallow wells in the vicinity of the landfill is believed to be representative of landfill leachate rather than groundwater beneath the Site. Monitoring wells positioned adjacent to the shallow wells, that were screened over deeper intervals below landfill wastes but within the bedrock aquifer, showed much lower concentrations of chromium. The concentrations of chromium detected in these deeper wells were below levels which posed a significant public health risk. The results from the sampling of these deeper wells, as well as from other wells throughout the Site, shows that trace metals are not impacting the groundwater beneath the Site and therefore the need for a groundwater treatment system to address soluble metal ions is not indicated at this time. An environmental monitoring program consisting of surface water and sediment sampling in the Branch River will be implemented to assure that the leachate collection system is meeting the response objectives of this Record of Decision. The details regarding the environmental monitoring program, including the frequency of sampling, sampling locations, and parameters to be sampled will be decided during the design phase.

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